National Aeronautics and Space Administration
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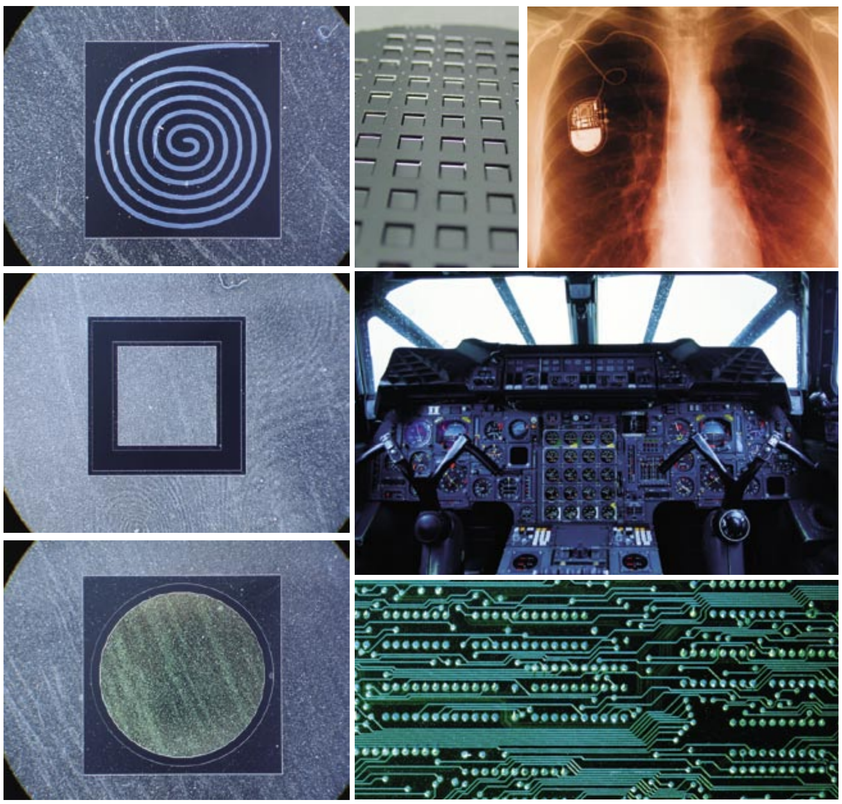
sensors and actuators

Real-Time Optical Parylene Thickness Sensor

... for accurate thickness of thin-film parylene



NASA Goddard Space Flight Center (GSFC) invites companies to license this real-time optical parylene thickness sensor technology. This highly accurate sensor greatly improves thickness control in parylene and other polymer deposition systems, providing alerts of batch-to-batch process variations and enabling precise and repeatable controls.

With accuracy greater than 95%, it provides real-time measurements of deposited film thickness ranging from .5 to 30 microns. In addition, this sensor technology lowers production time and cost by reducing errors and material waste. Because advanced applications of thin-film parylene are limited by the precision of the deposition, enhancing thickness monitoring and deposition may facilitate new applications for this material.

Benefits

- **Lowers costs**: By accurately depositing the right amount of parylene dimer, costs can be controlled and even lowered since undershooting and overshooting are unnecessary. This technology uses existing hardware that is widely used in the optics industry.
- **Saves time**: Real-time processing eliminates post-deposition monitoring. Run times are shortened because rerunning to add more material is eliminated.
- **Enables new applications**: Enhanced thickness monitoring enables the advancement of existing technologies.
- **Enables advancement toward ISO 9000 certifications**: By creating repeatable standards and reproducible measurements for film thickness, this technology can help companies advance towards achievement of ISO 9000 certification.

Applications

- **Microelectromechanical systems (MEMS)**: Microscale devices such as microtubes and microfluidic and micro-optical devices
- **Automotive**: Sensors and protective coatings for automotive electronics
- **Aerospace**: Sensors and protective coatings for electronics and other equipment
- **Electronics**: Stronger wire bonds, moisture barriers, dielectric coatings, and device dielectric layers (potential)
- **Medical**: Biocompatible coatings for medical devices (e.g., coronary stents, prosthesis, catheters, etc.)

Technology Details

NASA's new optical film thickness sensor can be used with parylene and other polymer deposition processes. The sensor optically measures the increasing parylene film thickness on the face of the sensor head. The polished face of the sensor head uses one or more polished optical fibers. As film deposits on the fibers, it creates a polymer Fabry-Perot cavity, which can be interrogated and measured. This measurement is directly correlated to the film thickness and maintains a thermally identical coating surface as the hardware being coated.

How it works

The sensor is secured to the coating chamber feed-through and has two optical fibers embedded into a silica base plate that has been polished to optical flatness. Light travels through the optical fibers to the base plate where the parylene film is being deposited. Because of the change in the indices of refraction, a portion of the light is reflected both where the parylene film meets the air and where the parylene film meets the optical fiber. These reflections have an optical path difference and, therefore, form an interference pattern. These resulting interference fringes are measured using basic interferometric techniques to produce real-time, accurate measurements that are directly correlated to the film thickness.

Additional fibers could be added for even greater accuracy. Because this sensor works in real time within the deposition chamber, it renders inconsequential the environmental factors experienced with other measurement techniques that affect deposition uniformity and accuracy.

Why it is better

Of the available thickness monitors, including quartz crystal oscillators and conductivity devices, none can provide the level of accuracy needed for parylene films—particularly when it is used in nanoscale devices such as microtubules and microfluidic chips.

This sensor is also versatile. In addition to parylene, this sensor can be readily applied to other deposited films including polymers. Adaptations only require the deposited material's index of refraction.

NASA Goddard Space Flight Center is seeking protection for this technology.

Licensing and Partnering Opportunities:

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Real-Time Optical Parylene Thickness Sensor (GSC-14757-1) for commercial applications.

For More Information

If you are interested in more information or want to pursue transfer of this technology (GSC-14757-1), please contact:

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More information about working with NASA Goddard's Office of Technology Transfer is available online:
http://techtransfer.gsfc.nasa.gov